DOE-ID NEPA CX DETERMINATION

CX Posting No.: DOE-ID-18-114

SECTION A. Project Title: Accident Tolerant Fuel Program – Westinghouse Electric Company, LLC

SECTION B. Project Description

The Westinghouse Accident Tolerant Fuel (ATF) program goals include the design, licensing and manufacture of Lead Test Rods for reactors and continues work on U_3Si_2 and UN fuels and Cr coated Zr and SiC cladding. Oxidation resistant U_3Si_2 is the main focus of this work with fuel options such as $U^{15}N$ and high thermal conductivity UO_2 as backup fuel options. SiC composite cladding from General Atomics consists of Hi-Nicalon-S SiC fibers infiltrated with SiC using chemical vapor infiltration (CVI) and an outer, hermetic layer of SiC deposited using chemical vapor deposition (CVD). Major organizations participating with Westinghouse Electric Company LLC on this project include:

- Westinghouse Electric Company LLC – Program management, fuel rod and assembly design, testing, business development and future planning (no significant emissions or uses of uranium or chemicals); lead test assembly (LTA) manufacture at the Columbia, SC facility; evaluation of samples from the MIT reactor at the Churchill, PA facility; high temperature corrosion, autoclave corrosion, and heat transfer testing at the Churchill, PA facility (no significant emissions or uses of uranium or chemicals); U_3Si_2 and UN corrosion studies at the Columbia, SC and Churchill, PA facilities; Cr coating of Zr rods at our Churchill facility; polishing of coated tubes (as part of ongoing Zr tube production) at the tube mill in Blairsville, PA (no significant emissions or uses of uranium or chemicals).
- Massachusetts Institute of Technology - In-reactor testing of SiC/Cr coated Zr cladding
- General Atomics - SiC cladding development and production and test rodlet assembly
- Idaho National Laboratory (INL) – Production of U_3Si_2 pellets and rodlets as well as ATR and TREAT irradiations and follow-on post-irradiation examination (PIE)
- Los Alamos National Laboratory (LANL) – Studies on U_3Si_2 production, oxidation resistance and handling
- University of Wisconsin – research on Cr coated Zr rods and coating of U_3Si_2 pellets for oxidation resistance
- Oak Ridge National Laboratory (ORNL) – SiC development, grid to rod abrasion (no significant emissions or uses of uranium or chemicals), HFIR irradiation of SiC CMCs and PIE
- Free Form Fibers – U_3Si_2 production
- University of South Carolina – SiC and coated cladding thermal-hydraulic studies using recirculating water loops (no significant emissions or uses of uranium or chemicals)
- University of Virginia – SiC mechanical versus hermeticity behavior (no significant emissions or uses of uranium or chemicals)
- Rennselaer Polytechnic Institute, University of Wisconsin, Texas A&M University and University of Texas at San Antonio – U_3Si_2 oxidation resistance
- University of Tennessee – enhanced thermal conductivity UO_2 (computer studies with no significant emissions or uses of uranium or chemicals)
- Exelon - Customer for ATF lead test rods (LTRs), licensing, design reviews (no significant emissions or uses of uranium or chemicals)
- Fauske & Associates – Accident modeling (no significant emissions or uses of uranium or chemicals)
- Air Liquide – N^{15} separation – modeling and simulation studies; there may be some testing to generate separations data using NH_3

SECTION C. Environmental Aspects / Potential Sources of Impact

Radioactive Material Use/Radioactive Waste Generation:

LANL - (coating U_3Si_2 pellets), Free Form Fibers (FFF – manufacture of U_3Si_2 from UF_6), Rennselaer Polytechnic Institute (making pellets with spark plasma sintering), University of Wisconsin (dip coating U_3Si_2 pellets), University of Texas at San Antonio (making U_3Si_2 using UC as a feed material) and Texas A&M University (coating particles of U_3Si_2 with BeO), Westinghouse Columbia (assembly of reactor components and oxidation testing of U_3Si_2 and UN), and Westinghouse Churchill (oxidation testing of U_3Si_2 and UN) will handle the radioactive material under approved Integrated Work Documents which document the relevant procedures, handling limits, safety procedures and disposal routes. They are only handling fresh fuel material. For all non-irradiated fuels, clean uranium containing materials originating from rejected samples (mainly pellets) are crushed and re-used in manufacturing new pellets. Uranium containing other solids materials (dirt), are disposed of by each institution using well established procedures consistent with their license. The amounts of uranium involved are hard to estimate but are all likely to be <500 gms at each institution.

Westinghouse will handle small quantities (<500 grams) of fuel pellets which will result in small quantities of other chemicals (mainly neutralized and evaporated nitric acid) which are employed for processing and cleaning samples. All operations will be performed under authorized work procedures in authorized facilities. Waste profiles exist for disposal of all materials.

The primary mission of the Idaho National Laboratory (INL) is to perform nuclear energy research and development. INL has over 40 years of experience in the handling of radioactive materials and has extensive facilities, procedures and trained personnel in place for handling significant quantities of all types of radioactive materials. Under the current proposal, INL's primary role includes fabrication and characterization of enriched U_3Si_2 pellets for irradiation testing in the Advanced Test Reactor (ATR) and in Byron Unit 2. Pellets fabricated by INL will be fabricated using DOE-owned materials and the pellets will be owned by Department of Energy (DOE). INL will assemble the pellets into test rods for use in the ATR and Transient Reactor Test Facility (TREAT), and pellets for use in lead tests rods for irradiation in Byron Unit 2.

For all non-irradiated fuels, clean uranium containing materials originating from rejected samples (mainly pellets) are crushed and re-used in manufacturing new pellets. Uranium containing other solids materials (dirt) are disposed of by DOE along with other DOE-owned materials.

Subsequent post-irradiation examination (PIE) at INL facilities. The irradiated pellets and PIE samples will remain DOE property and will ultimately be disposed of by DOE along with other DOE-owned irradiated materials and samples.

General Atomics (GA) will assemble test rods and for irradiation in INL's ATR, with subsequent PIE at INL. Any uranium containing materials are returned to INL for re-use or disposal.

The cladding samples will be irradiated at the Massachusetts Institute of Technology Reactor and ORNL's High Flux Isotope Reactor (HFIR) along with other samples from academia and industry. After irradiation, the samples will be disposed of under their license. Incidental materials will be disposed of using their existing contaminated waste procedures. Their reactor already discharges spent nuclear fuel which is disposed of under their current license. Irradiated cladding samples will be studied at the Westinghouse Churchill facilities. All wastes will be disposed of as part of the ongoing radioactive hot cell waste disposal activities under the current Westinghouse license.

All entities handling uranium are in agreement states that license their facilities.

Chemical Use/Chemical Waste Disposal/Hazardous Waste Generation/Industrial Waste Generation:

The chemical vapor infiltration (CVI) operation will be performed at a subcontractor (General Atomics) site that does internal R&D using CVI services. Off-gases are scrubbed as part of the process, neutralized and discharged as industrial waste.

University of Wisconsin and LANL will generate wastes from their coating processes. These wastes are non-hazardous and will be disposed of using their accepted disposal processes.

The waste stream from Cr coating activities at Westinghouse Churchill consists of Cr powder from overspray. Quantities will be less than 500 kg and will be disposed of as solid industrial waste under the current Westinghouse environmental licenses. Gaseous emissions from the Westinghouse Churchill, LANL and University of Wisconsin consist of Ar, N_2 and He and are released to the atmosphere after scrubbing and filtration. Quantity is unknown.

Air Liquide may perform NH_3 distillation tests at their R&D facilities to generate separation coefficients if the design studies indicate that their process is economically viable. There will be no large releases NH_3 to the environment from this work except for incidental leaks from equipment in fume hoods. These emissions would likely be less than 1 kg over the life of the project.

Water/Well Use:

All steps will require some water use for cooling, cleaning samples, and cleanup. No extraordinary water use is expected above current levels.

SECTION D. Determine the Level of Environmental Review (or Documentation) and Reference(s): Identify the applicable categorical exclusion from 10 CFR 1021, Appendix B, give the appropriate justification, and the approval date.

Note: For Categorical Exclusions (CXs) the proposed action must not: 1) threaten a violation of applicable statutory, regulatory, or permit requirements for environmental, safety, and health, including requirements of DOE orders; 2) require siting and construction or major expansion of waste storage, disposal, recovery, or treatment facilities; 3) disturb hazardous substances, pollutants, contaminants, or CERCLA-excluded petroleum and natural gas products that pre-exist in the environment such that there would be uncontrolled or unpermitted releases; 4) adversely affect environmentally sensitive resources. In addition, no extraordinary circumstances related to the proposal exist which would affect the significance of

the action, and the action is not "connected" nor "related" (40 CFR 1508.25(a)(1) and (2), respectively) to other actions with potentially or cumulatively significant impacts.

References: B3.6 Siting, construction, modification, operation, and decommissioning of facilities for small-scale research and development projects; conventional laboratory operations (such as preparation of chemical standards and sample analysis); and small-scale pilot projects (generally less than 2 years) frequently conducted to verify a concept before demonstration actions, provided that construction or modification would be within or contiguous to a previously disturbed or developed area (where active utilities and currently used roads are readily accessible). Not included in this category are demonstration actions, meaning actions that are undertaken at a scale to show whether a technology would be viable on a larger scale and suitable for commercial development.

Programmatic Spent Nuclear Fuel Management and Idaho National Engineering Laboratory Environmental Restoration and Waste Management Programs Final Environmental Impact Statement and Record of Decision (DOE/EIS-0203, 1995) and supplemental analyses (DOE/EIS-0203-SA-01 and DOE/EIS-0203-SA-02) and the Amended Record of Decision (1996)

Final Environmental Impact Statement for the Waste Isolation Pilot Plant (DOE/EIS-0026, October 1980) and Final Supplement Environmental Impact Statement for the Waste Isolation Pilot Plant (SEIS-I) (DOE/EIS-0026-FS, January 1990)

Final Waste Management Programmatic Environmental Impact Statement [WM PEIS] (DOE/EIS-0200-F, May 1997) and Waste Isolation Plant Disposal Phase Supplemental EIS (SEIS-II) (DOE/EIS-0026-S-2, September 1997)

Final Environmental Impact Statement for the Nevada Test Site and Off-Site Locations in the State of Nevada (DOE/EIS-0243) and supplemental analysis (SA) (DOE/EIS-0243-SA-01).

Final Environmental Assessment and Finding of No Significant Impact for the Replacement Capability for Disposal of Remote-Handled Low-Level Radioactive Waste Generated at the Department of Energy's Idaho Site (DOE/EA-1793, December 2011)

Universities and industry partners that handle uranium and radioactive materials have existing NRC licenses.

Justification: The activity consists of research and development of accident tolerant fuels to support of deployment in commercial reactors.

Is the project funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act) ☐ Yes ☒ No

Approved by Jason Sturm, DOE-ID NEPA Compliance Officer on 12/17/2018